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Claims

[c1] 1. A method of doping sidewalls of an isolation trench, comprising the steps of:
providing a substrate having a plurality of trenches thereon;
forming a blocking layer in each trenches such that the top surface of the blocking layer is lower than the top surface of the substrate;
performing a sidewall doping process to form a doped region in the substrate at the upper trench sidewall; and
removing the blocking layers within the trenches.

[c2] 2. The method of claim 1, wherein the dopants in the sidewall doping process for forming the doped region are complementary to the ones for forming a doped source/drain region in the substrate adjacent to the trenches thereafter.

[c3] 3. The method of claim 2, wherein the sidewall doping process comprises an ion implantation.

[c4] 4. The method of claim 3, wherein the ion implantation is carried out using an energy level between 5 to 40 KeV, a dosage between 5E12 to 1E14 ions/cm^2 and a slant

angle relative to a direction perpendicular to the substrate of between 5 to 30°.

[c5] 5. The method of claim 2, wherein the depth of the doped region in the sidewall doping process is shallower than the junction depth of the subsequently formed source/drain region in the substrate adjacent to the trenches.

[c6] 6. The method of claim 1, wherein the step of forming the blocking layers comprises:
forming a blocking material layer over the substrate that completely fills the trenches and covers the top surface of the substrate; and
performing an etching operation to remove the blocking material layer over the substrate and a portion of the blocking material layer within the trenches so that a portion of the blocking material layer remains within the trenches to form a blocking layer.

[c7] 7. The method of claim 6, wherein the blocking layer is selected from a group consisting of a photoresist layer, an anti-reflecting coating, a spin-on dielectric layer, a doped dielectric layer, a thermoplastic polymer, a thermal-hardening layer and a radiation-hardening layer.

[c8] 8. The method of claim 7, wherein the step for forming

the blocking layer further comprises performing a spin-on coating process or performing a chemical vapor deposition.

[c9] 9. The method of claim 6, wherein the etching process further comprises performing a reaction ion etching operation or performing a wet etching operation.

[c10] 10. A method of doping sidewalls of an isolation trench, comprising the steps of:
providing a substrate divided into a first region and a second region, wherein the substrate has a plurality of trenches in the first region and the second region;
forming a blocking material layer over the substrate that completely fills the trenches;
forming a mask layer over the substrate to cover the second region;
performing an etching operation to remove a portion of the blocking material layer so that the top surface of the blocking material layer within the trenches in the first region is lower than the top surface of the substrate;
performing a sidewall doping process to form a doped region in the substrate at the upper trench sidewall; and
removing the mask layer and the blocking material layer.

[c11] 11. The method of claim 10, wherein the etching process is carried out before forming the mask layer.

[c12] 12. The method of claim 10, wherein the etching process is carried out after forming the mask layer.

[c13] 13. The method of claim 10, wherein the etching process comprises performing a reactive ion etching process or performing a wet etching process.

[c14] 14. The method of claim 10, wherein the blocking material layer is selected from a group consisting of a photoresist layer, an anti-reflecting coating, a spin-on dielectric layer and a doped dielectric layer, and the mask layer comprises a photoresist layer.

[c15] 15. The method of claim 14, wherein the step for forming the blocking layer further comprises performing a spin-on coating process or performing a chemical vapor deposition.

[c16] 16. The method of claim 10, wherein the dopants in the sidewall doping process for forming the doped region are complementary to the ones for forming a doped source/drain region in the first region of the substrate adjacent to the trenches thereafter.

[c17] 17. The method of claim 16, wherein the sidewall doping process comprises an ion implantation.

[c18] 18. The method of claim 17, wherein the ion implanta-

tion is carried out using an energy level between 5 to 40 KeV, a dosage between 5E12 to 1E14 ions/cm^2 and a slant angle relative to a direction perpendicular to the substrate of between 5 to 30°.

[c19] 19. The method of claim 16, wherein the depth of the doped region in the sidewall doping process is shallower than the junction depth of the subsequently formed source/drain region in the first region of the substrate adjacent to the trenches.

[c20] 20. The method of claim 10, wherein different types of MOS devices are formed on the first region and the second region of the substrate.

[c21] 21. A method of doping sidewalls of an isolation trench, comprising the steps of:
providing a substrate divided into a first region and a second region, wherein the first region and the second region of the substrate have a plurality of trenches thereon;
forming a blocking layer over the substrate, wherein the blocking layer in the second region completely fills the trenches and covers the substrate surface whereas the blocking layer in the first region fills the trenches but exposes the top surface of the substrate, and the top surface of the blocking layer within the first region is

lower than the top surface of the substrate;
performing a sidewall doping process to form a doped region in the substrate at the upper trench sidewall; and
removing the blocking layer.

[c22] 22. The method of claim 21, wherein the step for forming the blocking layer comprises:
forming a blocking material layer over the substrate that completely fills the trenches in the first region and the second region, wherein the blocking layer in the second region is thicker than the blocking layer in the first region; and
performing an etching operation to remove a portion of the blocking material layer to form the blocking layer.

[c23] 23. The method of claim 22, wherein the step for forming the blocking material layer comprises:
forming a material layer over the substrate to fill the trenches in the first region and the second region such that the blocking layer in the second region and the blocking layer in the first region have almost identical thickness; and
performing a nanoimprint process by pressing a mold into the material layer so that thickness of the material layer in the first region is reduced.

[c24] 24. The method of claim 23, wherein the mold has a

pattern at least comprising a protruded section and a recess section such that the protruded section corresponds to the first region of the substrate and the recess section corresponds to the second region of the substrate.

[c25] 25. The method of claim 23, wherein the material layer is selected from a group consisting of a photoresist layer, an anti-reflecting coating, a spin-on dielectric layer, a doped dielectric layer, a thermoplastic polymer, a thermal-hardening layer and a radiation-hardening layer.

[c26] 26. The method of claim 25, wherein the step of pressing the mold against the material layer further comprises performing a hardening process.

[c27] 27. The method of claim 26, wherein the hardening process further comprises performing a heating process or performing an irradiation process.

[c28] 28. The method of claim 22, wherein the etching process comprises performing a reactive ion etching process or performing a wet etching process.

[c29] 29. The method of claim 21, wherein the dopants in the sidewall doping process for forming the doped region are complementary to the ones for forming a doped source/drain region in the first region of the substrate adjacent to the trenches thereafter.

[c30] 30. The method of claim 21, wherein the sidewall doping process comprises an ion implantation.

[c31] 31. The method of claim 30, wherein the ion implantation is carried out using an energy level between 5 to 40 KeV, a dosage between 5E12 to 1E14 ions/cm^2 and a slant angle relative to a direction perpendicular to the substrate of between 5 to 30°.

[c32] 32. The method of claim 21, wherein the depth of the doped region in the sidewall doping process is shallower than the junction depth of the subsequently formed source/drain region in the first region of the substrate adjacent to the trenches.

[c33] 33. The method of claim 21, wherein different types of MOS devices are formed on the first region and the second region of the substrate.